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(54) **FOLDING UNIT FOR FORMING SEALED PACKAGES OF POURABLE FOOD PRODUCTS**

(75) Inventors: **Stefano Paradisi**, Carpi (IT); **Matteo Galloni**, Nonantola (IT); **Roberto De Pietri Tonelli**, Formigine (IT)

(73) Assignee: **TETRA LAVAL HOLDINGS & FINANCE S.A.**, Pully (CH)

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USPC 493/243, 175, 180, 183, 189, 197, 202, 493/241, 250, 252
See application file for complete search history.

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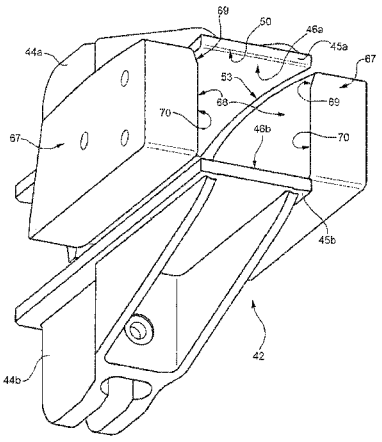
Assistant Examiner — Valentin Neacsu
(74) *Attorney, Agent, or Firm* — Buchanan Ingersoll & Rooney PC

(57) **ABSTRACT**

There is described a folding unit for forming sealed packages of pourable food products, comprising: at least one conveying device for feeding along a forming path a relative pack which have at least one portion to be folded to form a finished package; at least one folding device interacting, in use, with pack along said forming path and adapted to fold said at least one portion; conveying device comprises a first and a second surface opposite to another and adapted, in use, to cooperate respectively with a front and a rear wall opposite to each other of relative pack to be folded; first surface is at least partially concave.

8 Claims, 6 Drawing Sheets



(51) **Int. Cl.**
B65B 35/26 (2006.01)
B65B 9/20 (2012.01)

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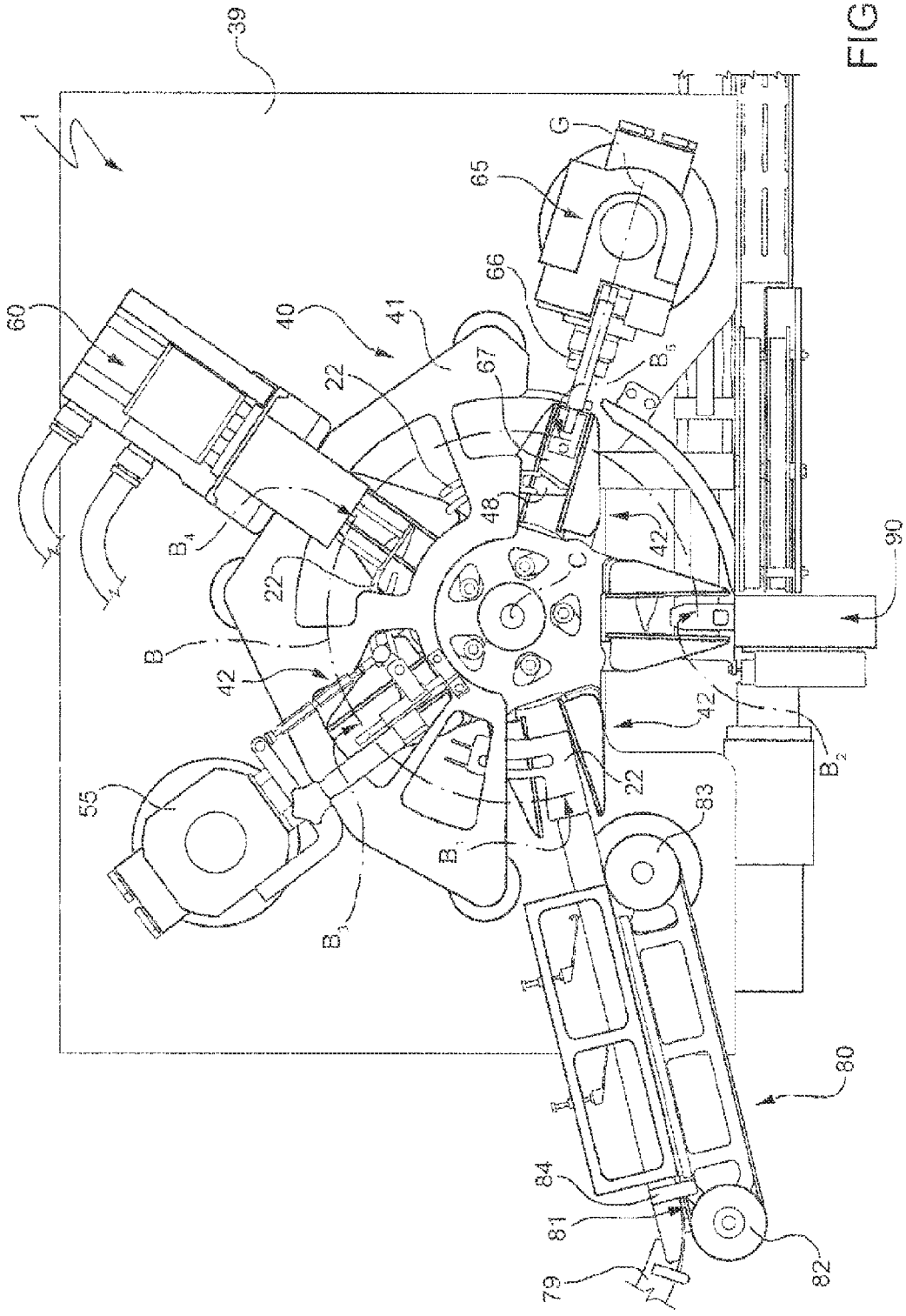
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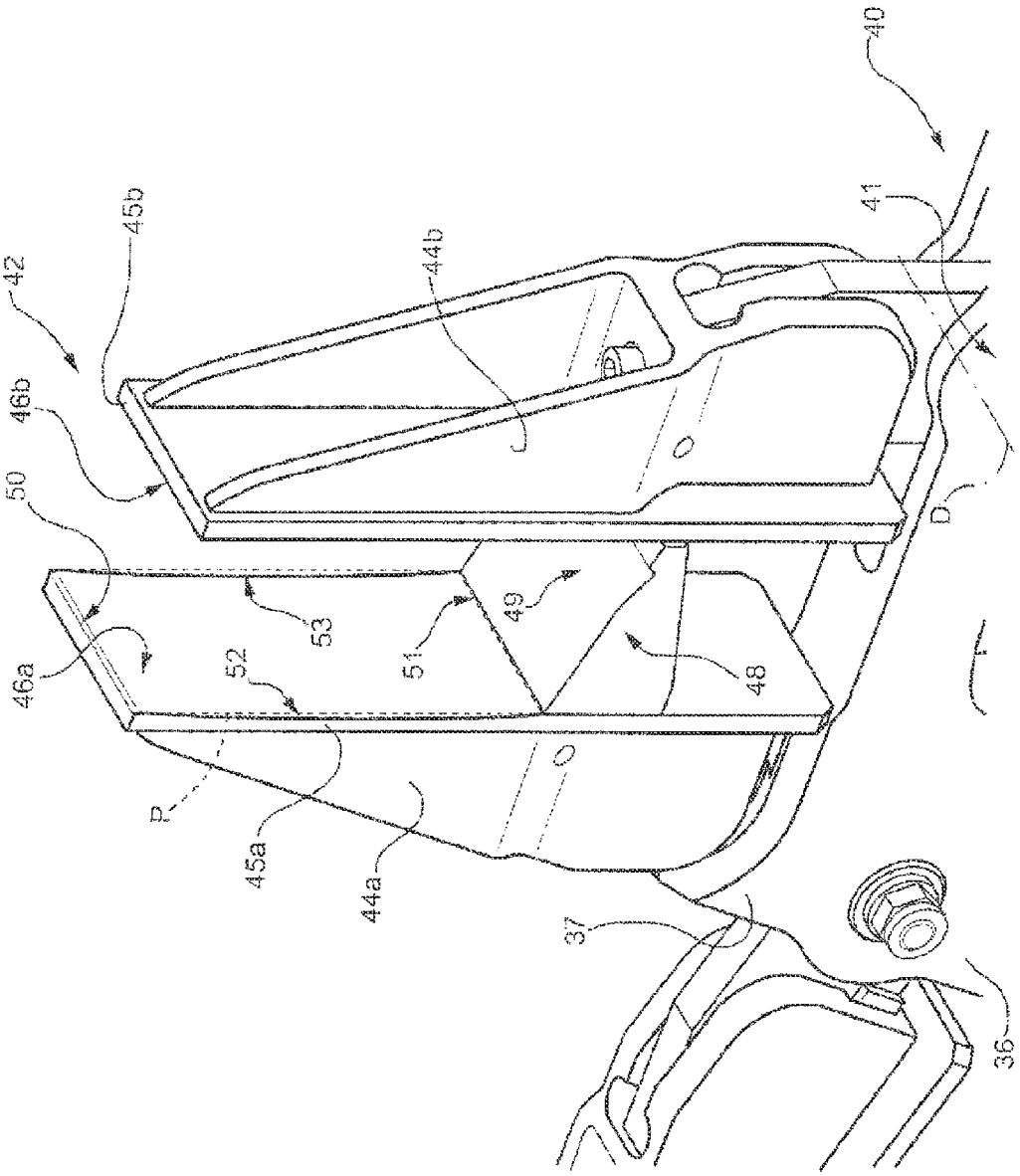
FIG. 1

FIG. 2



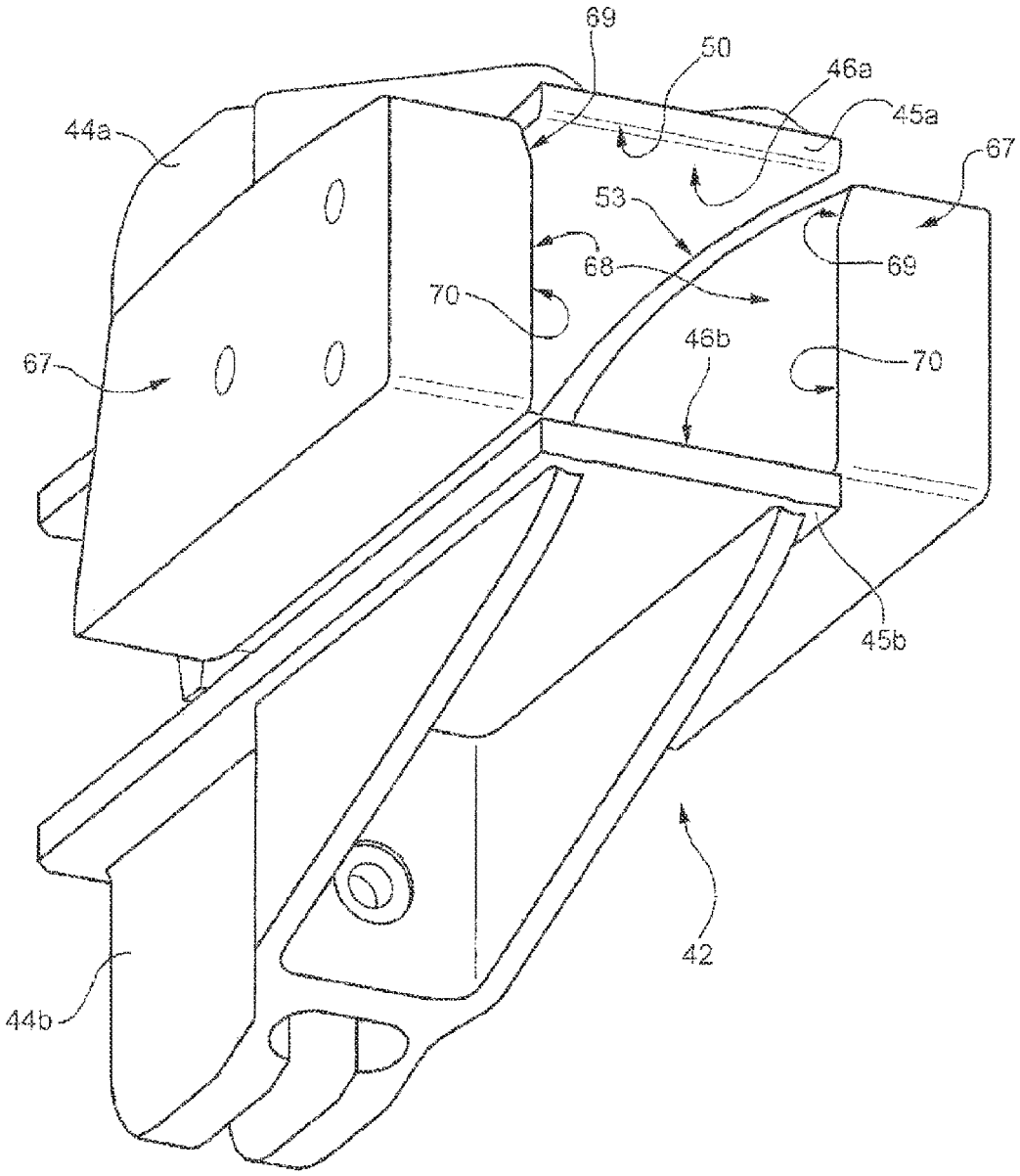


FIG. 3

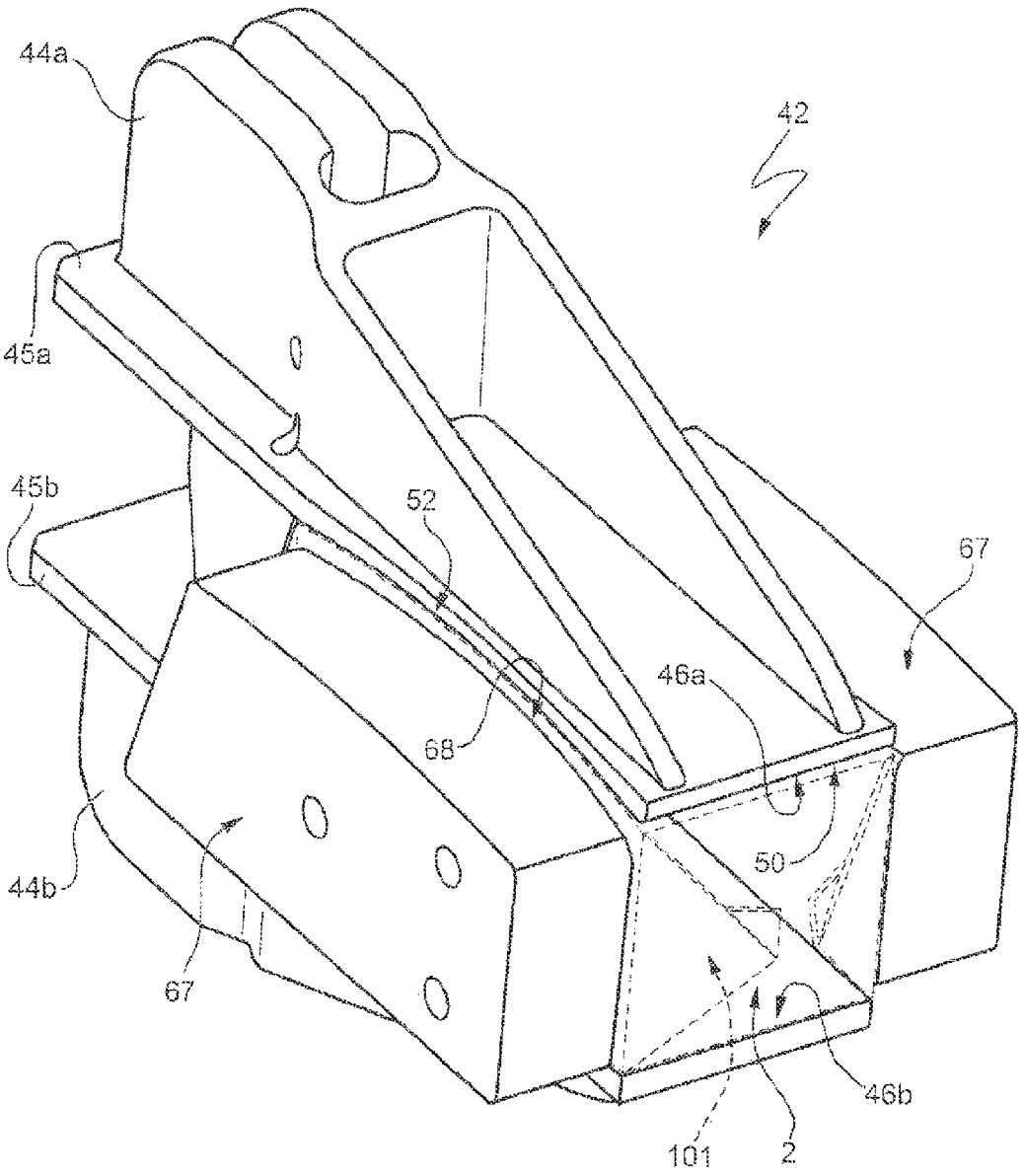


FIG. 4

FIG. 5

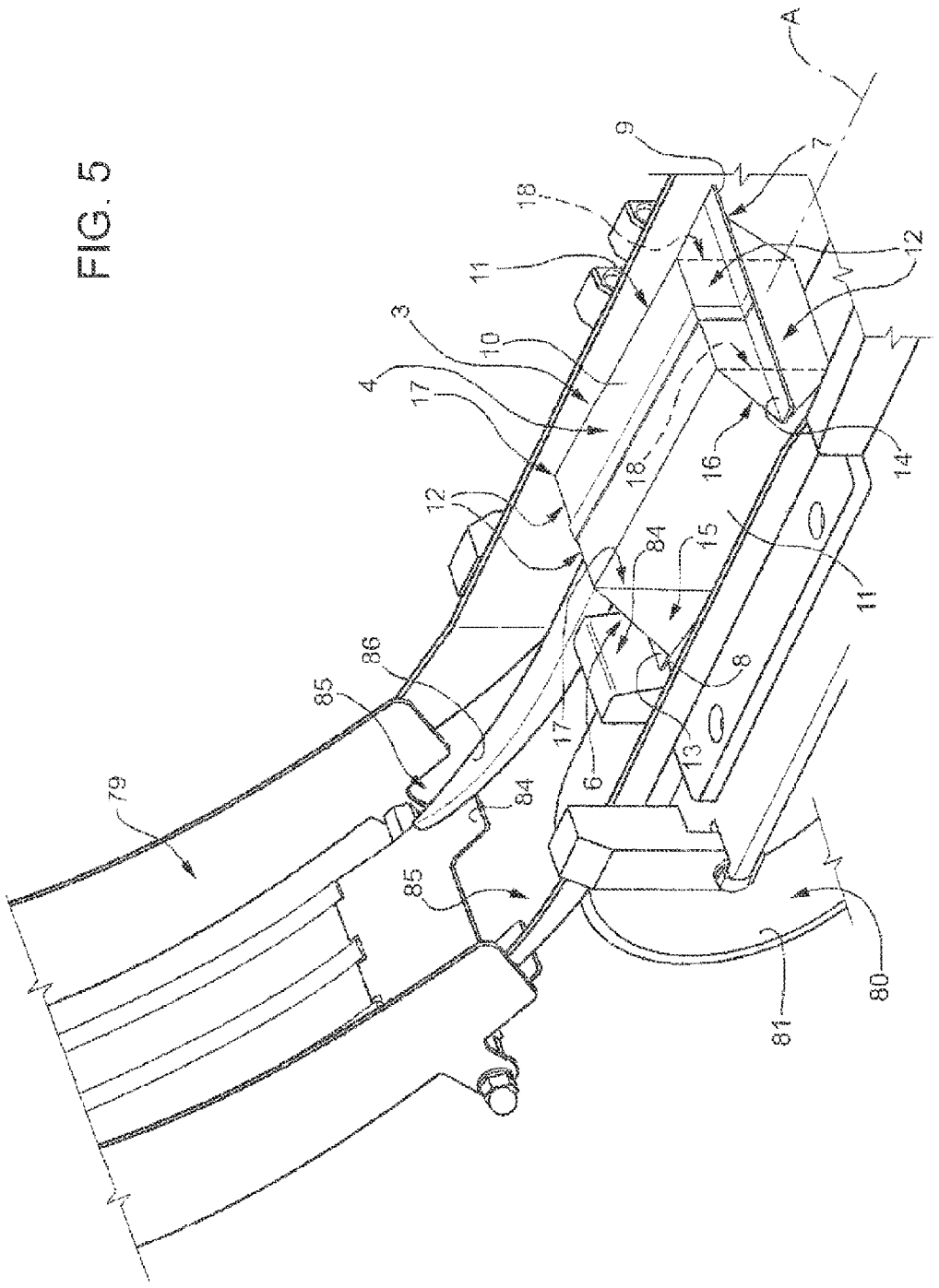
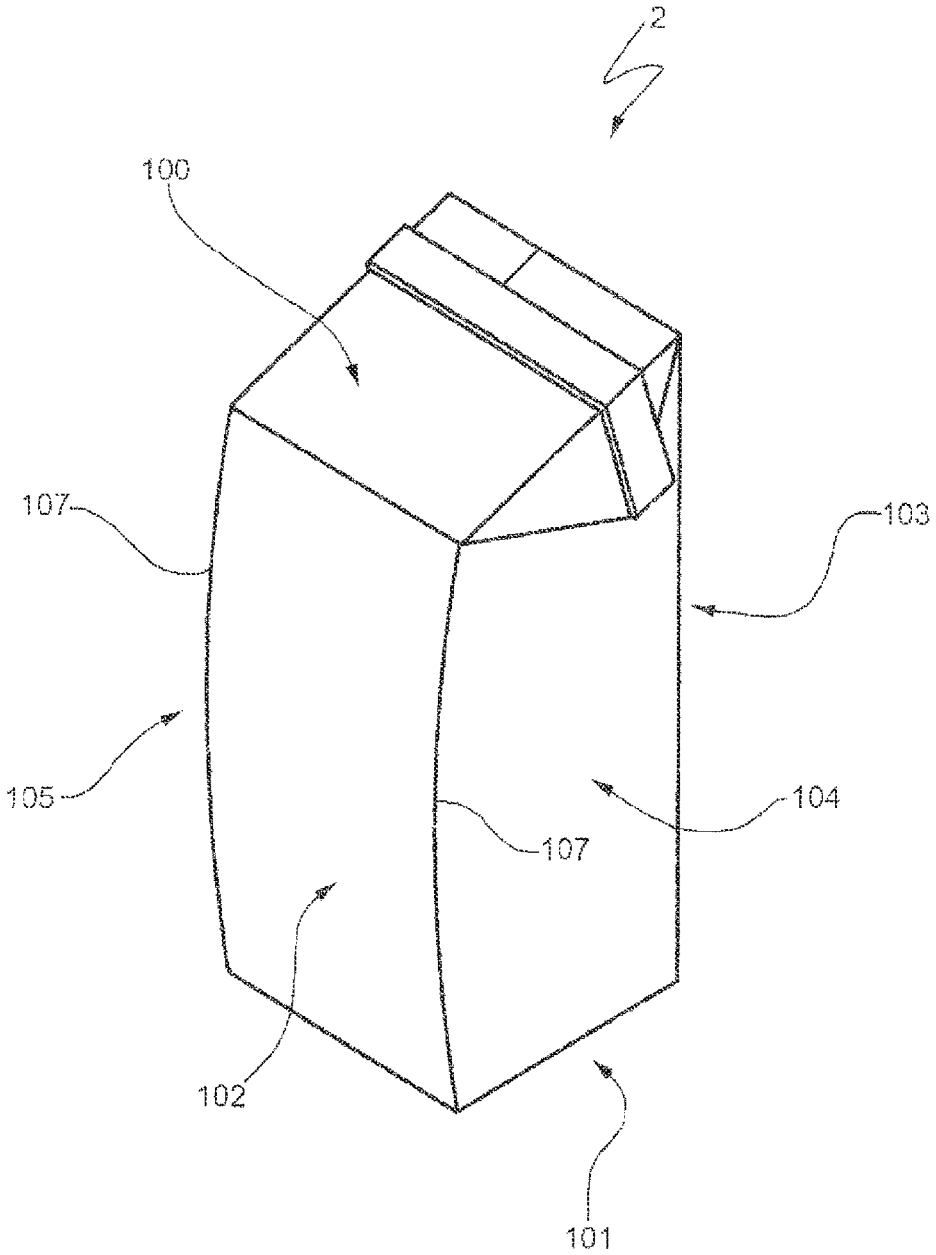


FIG. 6



FOLDING UNIT FOR FORMING SEALED PACKAGES OF POURABLE FOOD PRODUCTS

TECHNICAL FIELD

The present invention relates to a folding unit for forming sealed packages of pourable food product.

BACKGROUND ART

As is known, many liquid or pourable food products, such as fruit juice, UHT (ultra-high-temperature treated) milk, wine, tomato sauce, etc., are sold in packages made of sterilized packaging material.

A typical example is the parallelepiped-shaped package for liquid or pourable food products known as Tetra Brik Aseptic (registered trademark), which is made by creasing and sealing laminated strip packaging material. The packaging material has a multilayer structure comprising a base layer, e.g. of paper, covered on both sides with layers of heat-seal plastic material, e.g. polyethylene. In the case of aseptic packages for long-storage products, such as UHT milk, the packaging material also comprises a layer of oxygen-barrier material, e.g. an aluminium foil, which is superimposed on a layer of heat-seal plastic material, and is in turn covered with another layer of heat-seal plastic material forming the inner face of the package eventually contacting the food product.

Packages of this sort are normally produced on fully automatic packaging machines, on which a continuous tube is formed from the web-fed packaging material; the web of packaging material is sterilized on the packaging machine, e.g. by applying a chemical sterilizing agent, such as a hydrogen peroxide solution, which, once sterilization is completed, is removed from the surfaces of the packaging material, e.g. evaporated by heating; the web so sterilized is then maintained in a closed, sterile environment, and is folded and sealed longitudinally to form a tube, which is fed vertically.

In order to complete the forming operations, the tube is filled with the sterilized or sterile-processed food product, and is sealed and subsequently cut along equally spaced cross sections.

More precisely, the tube is sealed longitudinally and transversally to its own axis.

Pillow packs are so obtained, which have a longitudinal seal and a pair of top and bottom transversal seals.

Alternatively, the packaging material may be cut into blanks, which are formed into packages on forming spindles, and the packages are then filled with the food product and sealed. One example of this type of package is the so-called "gable-top" package known by the trade name Tetra Rex (registered trademark).

More specifically, the pillow packs comprise a parallelepiped-shaped main portion; and opposite, respectively top and bottom, end portions tapering from the main portion to respective sealing lines crosswise to the pack. Each end portion has substantially triangular flaps projecting from opposite sides of the main portion; and a low rectangular tab projecting from the relative sealing line.

Packaging machines of the above type are known, on which the pillow packs are turned into folded packages by automatic folding units.

Folding units are known, for example from the International Application No WO2008122623 in the name of the same Applicant, which substantially comprise:

- a rotary conveyor which receives pillow packs to be folded at inlet station, conveys pillow packs to be folded along an arc-shaped folding path, and outputs folded packages at an output station;
- a first folding unit which interacts with a bottom portion of the pack travelling along the folding path to perform a folding operation onto the packs;
- a heating device for heating the flaps of the packs travelling along the folding path; and
- a second folding device for pressing flaps of each pack travelling along forming path onto respective wall, as flaps cool.

In greater detail, rotary conveyor comprises a plurality of angular-spaced conveying devices, which grip packs at inlet station, and feed them along a forming path to output station.

Each conveying device comprises two flat surfaces which face each other and cooperate, in use, respectively with a front and a rear wall of the main portion of the relative pack to be folded.

A need is felt within the industry for the maximum flexibility as regards the final shape of packages folded by the folding machine.

This is particularly so in the case of newly conceived packages which have a front wall bulging on the opposite side of a rear wall.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a folding unit for producing sealed packages of pourable food products, and designed to provide the above aim in a straightforward, low-cost manner.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

FIG. **1** is a front view of a folding unit, for pourable food product packaging machines, in accordance with the present invention;

FIG. **2** is an enlarged perspective view of a first assembly of the folding unit of FIG. **1**, in a first angular position;

FIG. **3** is a perspective view of the first assembly of FIG. **1** in a second angular position and of a second assembly of the folding unit of FIG. **1**;

FIG. **4** is a perspective view taken under a different visual angle of the first assembly and second assembly of FIG. **3**;

FIG. **5** is an enlarged perspective view of a third assembly of the folding unit of FIG. **1**; and

FIG. **6** is a perspective enlarged view of a package folded by the folding unit of FIG. **1**.

BEST MODE FOR CARRYING OUT THE INVENTION

Number **1** in FIG. **1** indicates as a whole a folding unit for a packaging machine for continuously producing sealed, parallelepiped-shaped packages **2** (FIG. **6**) of a pourable food product, such as pasteurized or UHT milk, fruit juice, wine, etc., from a known tube, not shown, of packaging material.

More specifically, the tube is formed in a known manner upstream from folding unit **1** by longitudinally folding and sealing a web of heat-seal sheet material, and is filled with the sterilized or sterile-processed food product.

The tube of packaging material is then sealed and cut along equally spaced cross sections to form a number of pillow packs **3** (FIG. **5**), which are then sent to unit **1** where they are folded mechanically into respective packages **2**.

With reference to FIG. **5**, each pack **3** has an axis A, and comprises a parallelepiped-shaped main portion **4**; and opposite, respectively top and bottom, end portions **6**, **7** tapering from portion **4** to respective sealing lines **8**, **9**, crosswise to axis A, of pack **3**.

More specifically, portion **4** of each pack **3** is bounded laterally by two rectangular walls **10**, that are opposite to each other, on either side of axis A; and by two concave walls **11** extending between walls **10**.

In detail, a first wall **10** intended to form front wall **102** of folded package **2** is convex and a second wall **10** intended to form rear wall **103** of folded package **2** is flat.

Each portion **6**, **7** is defined by two walls **12** substantially in the form of an isosceles trapezium, sloping slightly towards each other with respect to a plane perpendicular to axis A, and having minor edges defined by respective end edges of walls **10** of portion **4**, and major edges joined to each other by the respective sealing line **8**, **9**.

For each portion **6**, **7**, each pack **3** has an elongated, substantially rectangular tab **13**, **14** projecting from respective sealing line **8**, **9**; and two substantially triangular flaps **15**, **16** projecting laterally from opposite sides of portion **4** and defined by end portions of relative walls **12**.

With reference to FIG. **6**, package **2** has a top panel of the type disclosed in the European Application no. 10165116, which is hereby incorporated by reference.

Very briefly, package **2** comprises:

- a slanted top wall **100**;
- a bottom wall **101**;
- a convex front and a flat rear wall **102**, **103** which extend between walls **100**, **101**; and
- a pair of concave lateral walls **104**, **105** which extends between walls **100**, **101** and between walls **102**, **103**.

Furthermore, convex front wall **102** is laterally bounded by to curved crease lines **107** which are opposite to each other and extend between walls **100**, **101**.

To form a package **2**, unit **1** presses portions **6**, **7** of pack **3** towards each other, while at the same time folding respective tabs **13**, **14** onto portions **6**, **7**; folds and seals flaps **15** of portion **6** onto relative walls **12**; and folds and seals flaps **16** of portion **7** onto respective walls **11** of portion **4**.

More specifically, flaps **15**, **16** are folded with respect to walls **12**, **11** about respective fold lines **17**, **18** coincident with respective edges between walls **11** and portions **6**, **7**.

Unit **1** substantially comprises (FIG. **1**):

- a main conveyor **40** rotatable about an axis C and which feeds a succession of packs **3** in steps along an arc-shaped forming path B;
- a folding device **55** fitted to a fixed structure **39** of unit **1** have an interacting surface movable back and forth radially to axis C so as to interact with portions **6** of packs **3** travelling along path B to perform a folding operation on the packs;
- a heating device **60** fitted to structure **39** of unit **1** and which heats the unfolded flaps **15**, **16** of each pack **3** travelling along path B preparatory to heat sealing them onto respective walls **11**, **12**; and
- an additional folding device **65** fitted to structure **39** of unit **1** and having a pressure device **66** and a pair of pressure devices **67** for pressing flaps **15**, **16**, respectively of each pack **3** travelling along path B onto respective walls **12**, **11** as flaps **15**, **16** cool.

Furthermore, unit **1** also comprises a number of pairs of rails **22** fitted to the structure **39** of unit **1**. Rails **22** of each pair extend along path B on respective axial opposite sides of conveyor **40**, and cooperate with packs **3** along path B to perform a number of folding operations thereon.

In detail, path B extends from a loading station B_1, where conveyor **40** receives each pack **3** from an input conveyor **80**, to an unloading station B_2, where conveyor **40** unloads a relative package **2** (FIG. **4**) onto an output conveyor **90**.

From station B_1 towards station B_2, path B also comprises:

- a first portion, along which a first pair of rails **22** interact with each pack **3** to guide it along path B; and
- a station B_3 where the interacting surface of folding device **55** interacts with each pack **3** to convert it from a pillow configuration shown in FIG. **5** to a configuration in which portions **6**, **7** are pressed towards each other to fold walls **12** of portions **6** into a position perpendicular to axis A and to fold walls **12** of portion **7** into a position slanted relative to axis A; folding device **55** further folds tabs **13**, **14** onto respective walls **12**, flaps **15** about fold lines **17** into a position parallel to axis A, and flaps **16** about fold lines **18** into a position sloping slightly towards portion **6** relative to the folded wall **12** of portion **7**; and
- a second portion, along which a second pair of rails **22** interact with each pack **3** to convert it to a configuration in which flaps **15**, **16** slope forty-five degrees with respect to relative walls **12**, **11**, and extend from respective fold lines **17**, **18** towards axis A and away from axis A respectively.

From the second portion to station B_2, path B also comprises:

- a station B_4 where heating device **60** heats flaps **15**, **16** of each pack **3**, preparatory to heat sealing them onto respective walls **12**, **11**;
- a third portion, along which the third pair of rails **22** fold flaps **15**, **16** of each pack **3** to convert it to a configuration, in which flaps **15**, **16** slope roughly ten degrees with respect to walls **12**, **11**, and extend from fold lines **17**, **18** respectively towards axis A and away from axis A;
- a station B_5 where pressure devices **66** and **67** of folding device **65** fold respective flaps **15**, **16** of each pack **3** onto relative walls **12**, **11** to complete formation of package **2** (FIG. **4**); and
- a fourth portion terminating at station B_2, and along which a fourth pair of rails **22** keep flaps **16** pressed onto walls **11** to prevent accidental detachment of the flaps as they cool.

Conveyor **80** (FIG. **1**) comprises an endless belt looped about a not-shown drive pulley and a return pulley **82**, **83**; and a number of push members **84** (only one of which is shown in FIG. **5**) fitted given distances apart to belt **81**, and which interact with portions **6** of respective packs **3** to move the packs from an upstream chute **79** to conveyor **40**.

More specifically, push members **84** are equally spaced along belt **81**, and travel, in use, along an endless path of the same shape as belt **81**.

On conveyor **80**, each pack **3** is positioned with a first wall **10** facing conveyor **80**, with a second wall **10** facing away from conveyor **80** and with portion **6** resting against relative push member **84**.

Conveyor **80** also comprises a pair of stationary rails **85** which are arranged at opposite lateral sides of belt **81**. Rails **85** have relative portion **86** which are sloped relative to belt

81 and cooperate with respective portions of tabs 13, 14 that rest on portion 86 of rail 85, so as to protect the first wall 10.

Conveyor 40 comprises a hub 41 rotating about axis C; and a number of—in the example shown, five—conveying devices 42 for gripping respective packs 3 at station B_1 of path B, and feeding them along path B to station B_2, so packs 3 interact with rails 22, folding devices 55, 65, and heating device 60.

Hub 41 comprises a main body 36 and a plurality of pairs of arms 37 which radially protrude from the outer periphery of main body 36 (FIG. 2).

More specifically, hub 41 is rotated in steps about axis C by a motor not shown.

Conveying devices 42 are equally spaced angularly about axis C; and project from hub 41, on the opposite side to axis C and along respective radial directions relative to axis C.

Conveying devices 42 are therefore angularly integral with hub 41.

Each conveying device 42 comprises (FIGS. 2 to 4):

- a pair of supports 44*a*, 44*b* radially projecting from respective arm 37; and
- a pair of members 45*a*, 45*b* fixed to relative supports 44*a*, 44*b* and facing each other.

Support 44*b* of each conveying device 42 is hinged to respective arm 37 about an axis D parallel to axis C.

Support 44*a* of each conveying device 42 is fixed to respective arm 37.

Members 45*a*, 45*b* of each conveying device 42 comprise relative surfaces 46*a*, 46*b* which are elongated radially with respect to axis C and face each other.

Surfaces 46*a*, 46*b* cooperate with respective first and second walls 10 of relative pack 3, so as to hold pack 3 along path B.

In detail, surface 46*a* cooperates with first wall 10 of pack 3 intended to form front wall 102 of folded package 2 and surface 46*b* cooperates with second wall 10 of pack 3 intended to form rear wall 103 of folded package 2.

Advantageously, surface 46*a* is concave.

In detail, surface 46*a* is bounded by a rectilinear radial outer edge 50 and a radial inner edge 51 which are opposite to each other, and by a pair of edges 52, 53 which are opposite to each other and extend between edge 50, 51.

Edges 50, 51 define a theoretical plane P which is radial to axis C and edges 52, 53 extend on the opposite side of plane P relative to surface 46*b*.

In particular, edges 52, 53 extend at first at increasing distances and then at decreasing distances from plane P, proceeding radially to axis C from edge 50 to edge 51.

Furthermore, edges 52, 53 converge to each other and then diverge from each other, proceeding radially to axis C from edge 50 to edge 51, as shown in FIG. 4.

Surface 46*b* is, in the embodiment shown, planar.

Each conveying device 42 further comprises a slanted element 48 projecting from edge 51 of surface 46*a* of member 45*a* towards surface 46*b* and extending transversally to surface 46*b*.

Each element 48 comprises a surface 49 which is slanted relative to surface 46*a*. Surface 49 cooperates with portion 7 of each pack 3 which is moved along path B by relative conveying device 42.

With reference to FIGS. 1 to 4, pressure device 66 of folding device 65 is movable back and forth along an axis G radial to axis C between a work position, in which it presses flaps 15 of each pack 3 onto walls 12 of portion 6 of pack 3, and a rest position, in which it is detached from flaps 15.

Pressure devices 67 are movable back and forth between a work position, in which relative surfaces 68 press respective flaps 16 of each pack 3 onto respective walls 11, and a rest position, in which they are detached from flaps 16 to permit travel of pack 3 along path B (FIG. 6).

The movement of pressure device 67 is synchronized in a not shown manner with the movement of pressure device 66.

When pressure devices 66, 67 are in respective work position, each pressure device 67 extends between surfaces 46*a*, 46*b* of the conveying device 42 which is arranged at station B_5 (FIG. 3).

Surfaces 68 are advantageously convex, so as to form concave walls 104, 105 of the finished package 2.

In detail, each surface 68 comprises a first convex region 69 adjacent to surface 46*a* and a second convex region 70 adjacent to surface 46*b*, when pressure devices 66, 67 are in respective work position.

The curvature of surface 69 is higher than the curvature of surface 70.

Operation of unit 1 will be described with reference to one pack 3, and as of the instant in which a push member 84 of conveyor 80 feeds a corresponding conveying device 42 arranged at station B_1 with such a pack 3.

More specifically, member 45*b* of conveying device 42 is parted slightly, by rotation about axis D, from member 45*a* at station B_1, to permit insertion of pack 3.

As soon as pack 3 is inserted inside relative conveying device 42, members 45*a*, 45*b* are brought together so that surfaces 46*a*, 46*b* rest on respective first and second walls 10.

More specifically, pack 3 is housed inside conveying device 42 with portion 7 facing axis C and cooperating with surface 49 of element 48, and with portion 6 arranged on the opposite side of axis C. In this way, surface 49 of element 48 folds portion 7 so as to form top wall 101 of pack 3.

Pack 3 is moved along forming path B by conveyor 40 rotating clockwise, as seen in FIG. 1, about axis C.

As conveying device 42 moves from station B_1 to folding device 55, the first pair of rails 22 cooperates with lateral ends of tab 13 and with lateral ends of tab 14.

As conveying device 42 reaches station B_3, folding device 55 reaches the work position, in which it compresses the intermediate portion of wall 12, between flaps 15, of portion 6 towards axis C.

The above compression produces a slight translation of pack 3 towards axis C, so that flaps 15 rotate about respective fold lines 17 into a position parallel to axis A, and flaps 16 rotate about respective fold lines 18 into a position sloping roughly ten degrees with respect to the plane of top wall 100, after that folding of package 2 has been completed.

Afterwards, folding device 55 is moved towards its rest position.

Conveyor 40 then moves pack 3 along path B from folding device 55 to heating device 60.

In the same time, the second pair of rails 22 folds flaps 15, 16 towards axis A so that they, by the time they reach heating device 60, slope roughly forty-five degrees relative to walls 12, 11 respectively.

At station B_4, conveyor 40 stops, and heating device 60 blows hot air onto flaps 15, 16 of pack 3, preparatory to heat sealing the flaps to walls 12, 11.

Further rotation of conveyor 40 feeds pack 3 along of path B away from heating device 60 and towards folding device 65.

As conveying device 42 advances pack 3, the third pair of rails 22 folds flaps 15 towards wall 12 of portion 6 until it forms an angle of roughly ten degrees with walls 12, and fold flaps 16 towards walls 11 until flap 16 forms an angle of roughly ten degrees with relative wall 11.

As it reaches station B_5, conveyor **40** stops, and pressure devices **66**, **67** of folding device **65** are moved into their respective work positions. In the work position, pressure device **66** presses the heated flaps **16** onto walls **12** of pack **3**, and surfaces **68** of pressure device **67** press the heated flaps **16** onto walls **11** of pack **3** to complete package **2**.

Due to the fact that it is concave, surface **46***a* of conveying device **42** controls the shape of first wall **10** with which it cooperates as packs **3** travels along path B and, therefore, during the whole forming process of package **2**.

As a result, front wall **102** of package **2** is formed as convex.

In the very same way, surface **46***b* of conveying device **42** controls the shape of wall **10** with which it cooperates as packs **3** travels along path B and, therefore, during the whole forming process of package **2**.

As a result, rear wall **103** of package **2** is formed as flat.

Furthermore, surfaces **68** are convex and control the shape of flaps **16** and walls **11** during the final folding of pack **3**. Therefore, walls **104**, **105** of folded package **2** are formed as concave.

The pressure applied as described above seals flaps **15**, **16** to walls **12**, **11** so as to complete the formation of bottom wall **101**, lateral walls **104**, **105** and top wall **100** of package **2**.

As conveying device **42** reaches station B_2, member **45***b* is parted slightly relative to axis D from member **45***a* to withdraw surfaces **46***a*, **46***b* slightly from relative walls **10**.

Folded package **2** is then released to output conveyor **90**.

The advantages of unit **1** according to the present invention will be clear from the foregoing description.

In particular, concave surfaces **46***a* of conveying devices **42** control the shape of first walls **10** with which they cooperate as relative packs **3** are folded so as to form corresponding packages **2**. As a result, front walls **102** of packages **2** may be formed as having a convex shape.

Furthermore, edges **52**, **53** extend on the opposite side of plane P relative to surface **46***b* and control the shape of crease lines **107**, as packs **3** are folded to form corresponding packages **2**.

Accordingly, the desired shape of crease lines **107** of packages **2** may be obtained.

Finally, convex surfaces **67** control the shape of relative walls **11** of packs **3** with which they cooperate as these packs **3** are folded so as to form corresponding packages **2**. As a result, lateral walls **104**, **105** of packages **2** may be formed as having a concave shape.

Clearly, changes may be made to unit **1** as described and illustrated herein without, however, departing from the scope defined in the accompanying Claims.

In particular, unit **1** could be used for forming packages **2** having rear walls **103** which bulge on the opposite side of corresponding front walls **102**. In this case, surfaces **46***b* of conveying devices **42** would be concave.

The invention claimed is:

1. A folding unit for forming sealed packages of pourable food products, comprising:

at least one conveying device for feeding along a forming path a respective pack which includes at least one portion to be folded to form a finished package;

at least one folding device interacting, in use, with said respective pack along said forming path and adapted to fold said at least one portion;

said conveying device comprising first and second surfaces configured to cooperate respectively with a front wall and a rear wall of said respective pack to be folded, the front and rear walls of said respective pack facing away from one another; and

wherein said first surface is at least partially concavely curved.

2. The folding unit of claim **1**, wherein said conveying device is movable along a closed path which extends around an axis;

said conveying device comprising:

first and second edges, said first surface being bound between said first and second edges, said axis being closer to said second edge than to said first edge;

third and fourth edges which extend between said first and second edges; and

said third and fourth edges extending such that a theoretical plane defined by said first and second edges is located between said second surface and said third and fourth edges.

3. The folding unit of claim **2**, wherein said third and fourth edges extend at first at increasing distances and then at decreasing distances from said theoretical plane, proceeding from said first edge to said second edge.

4. The folding unit of claim **2**, wherein said third and fourth edges converge towards each other and diverge from each other, proceeding from said first edge to said second edge.

5. The folding unit of claim **1**, wherein said second surface is planar.

6. The folding unit of claim **1**, comprising a heating device configured to heat, in use, unfolded flaps of said respective pack;

said folding device being arranged downstream from said heating device along said path and comprising a pair of pressure devices;

said pressure devices comprising third surfaces, said pressure devices being movable between an operative position in which respective third surfaces press respective flaps of said respective pack onto respective lateral walls of said respective pack to be folded, and a rest position in which said respective third surfaces are detached from said respective pack; and

said third surfaces being convexly curved.

7. The folding unit of claim **1**, comprising:

a first conveyor; and

a second conveyor provided with a plurality of said conveying devices and fed, in use, by said first conveyor with said respective pack at an inlet station of said path;

said first conveyor comprising:

a closed-loop belt;

a plurality of push members fitted to said belt and adapted to travel along an endless path, said push members being arranged at fixed distances apart from one another and adapted to interact with said respective pack to move said respective pack towards said second conveyor as said push members travel along said endless path while said respective pack rests against a respective one of said push members; and

a pair of fixed rails which cooperate with said respective pack, so as to ensure that said respective pack remains detached from said belt.

8. A folding unit for forming sealed packages of pourable food products, comprising:

at least one conveying device for feeding along a forming path a respective pack which includes at least one portion to be folded to form a finished package;

said conveying device comprising a first surface and a second surface configured to cooperate respectively

with a front wall and a rear wall of said respective pack to be folded, the front and rear walls of said respective pack facing away from one another;

a heating device configured to heat, in use, unfolded flaps of said respective pack;

a folding device arranged downstream from said heating device along said path, comprising a pair of pressure devices and adapted to perform a folding operation onto said respective pack travelling, in use, along said path;

said pressure devices comprising third surfaces, said pressure devices being movable between an operative position in which respective third surfaces press respective flaps of said respective pack onto respective lateral walls of said respective pack to be folded, and a rest position in which said respective third surfaces are detached from said respective pack; and

wherein said first surface is at least partially concavely curved and said third surfaces are convexly curved.

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